Water Quality Progress Report

Salt Slough – Selenium

(*Approved 1999*)

WATER QUALITY STATUS

- TMDL targets achieved
- Conditions Improving
- Improvement needed
- Data inconclusive

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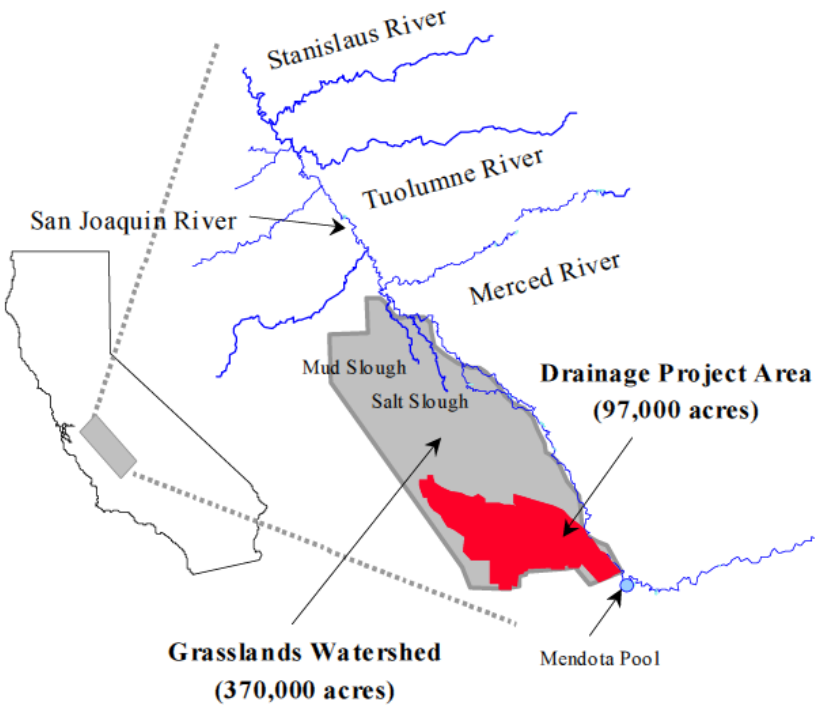
Last Updated 6/15/2015

Total Maximum Daily Load (TMDL) Summary

Waterbody – Salt Slough is one of two water bodies providing drainage for the Grassland Watershed. This watershed drains 370,000 acres in the Western portion of the San Joaquin River Basin in Merced County, California. A portion of the Grassland Watershed that generates subsurface drainage via tile drains is referred to as the Drainage Project Area (DPA) (97,000 acres). Prior to 1996, the DPA drained to both Salt Slough and Mud Slough (north), affecting water quality. Salt Slough discharges to the San Joaquin River just upstream of Mud Slough (north). Both sloughs discharge upstream of the Merced River (see map below). In 2010, Salt Slough was delisted for selenium.



Salt Slough and its drainage area

Water Quality Goals

According to the water quality objectives, **Selenium** is not to exceed a monthly mean concentration of 2 parts per billion (ppb or micrograms per liter [µg/L]) nor an instantaneous maximum concentration of 20 ppb in order to protect waterfowl using wetlands (Resolution No. 96-147).

Targeted Attainment Date – None specified in TMDL. However, this TMDL is implemented through a prohibition of discharge of agricultural subsurface drainage to Salt Slough. Compliance with the water quality objectives must occur by October 1, 1996, which is before U.S. Environmental Protection Agency (EPA) approval in August 1999.

Water Quality Impairment – Selenium is a bioaccumulative trace element that is an essential nutrient for animals; however, ingestion of too much selenium can be toxic to sensitive species. Selenium can be mobilized and accumulated through the food chain, causing adverse

growth and reproductive effects in both fish and birds. Elevated concentrations of selenium have been linked to deformities and deaths of aquatic birds.

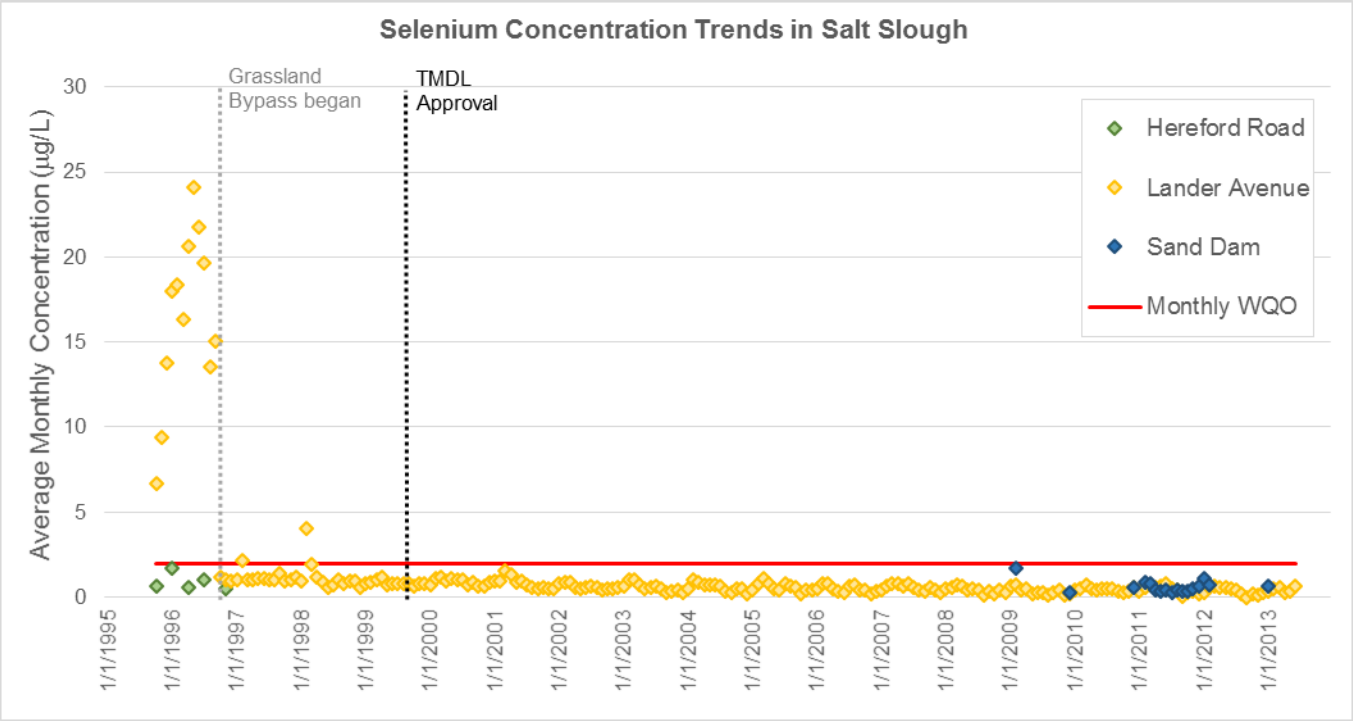
The Central Valley Regional Water Quality Control Board (Central Valley Water Board) has monitored selenium levels in the Grassland Watershed since 1985. These monitoring data confirmed high selenium concentrations in Salt Slough and other water bodies within the watershed and downstream. The source of the elevated concentrations was traced to subsurface drainage discharges from the DPA. The subsurface drainage was being utilized to augment limited water supplies for the Grassland wetlands with Salt Slough serving as one of the supply canals. The elevated selenium concentrations were above the selenium criteria being proposed by the U.S. Fish and Wildlife Service to protect waterfowl; therefore, in 1990, Salt Slough was added to the California List of Impaired Waterbodies.

Pollutant Sources – Some soils in the Coast Range are derived from marine sediments, which are naturally high in salts and selenium. The soluble salts and selenium have historically migrated with groundwater to the valley floor where it resides in an unconfined, shallow groundwater layer above the Corcoran Clay Layer. Irrigation is necessary for nearly all crops grown commercially in the watershed and causes the groundwater to rise. Subsurface drainage, specifically from tile drains in the DPA, is produced when farmers drain the salty groundwater from the root zone to protect their crops. These land use practices accelerate the movement of selenium from groundwater to surface water. Selenium concentrations in subsurface drainage have been measured at 20 to 250 times higher than the monthly mean water quality objective. Further data analyses confirmed that other sources such as wetlands discharge and surface drainage were not identified as significant and subsurface discharge from the DPA was the primary selenium source to Salt Slough. The TMDL identified nonpoint sources of selenium that discharge to the slough.

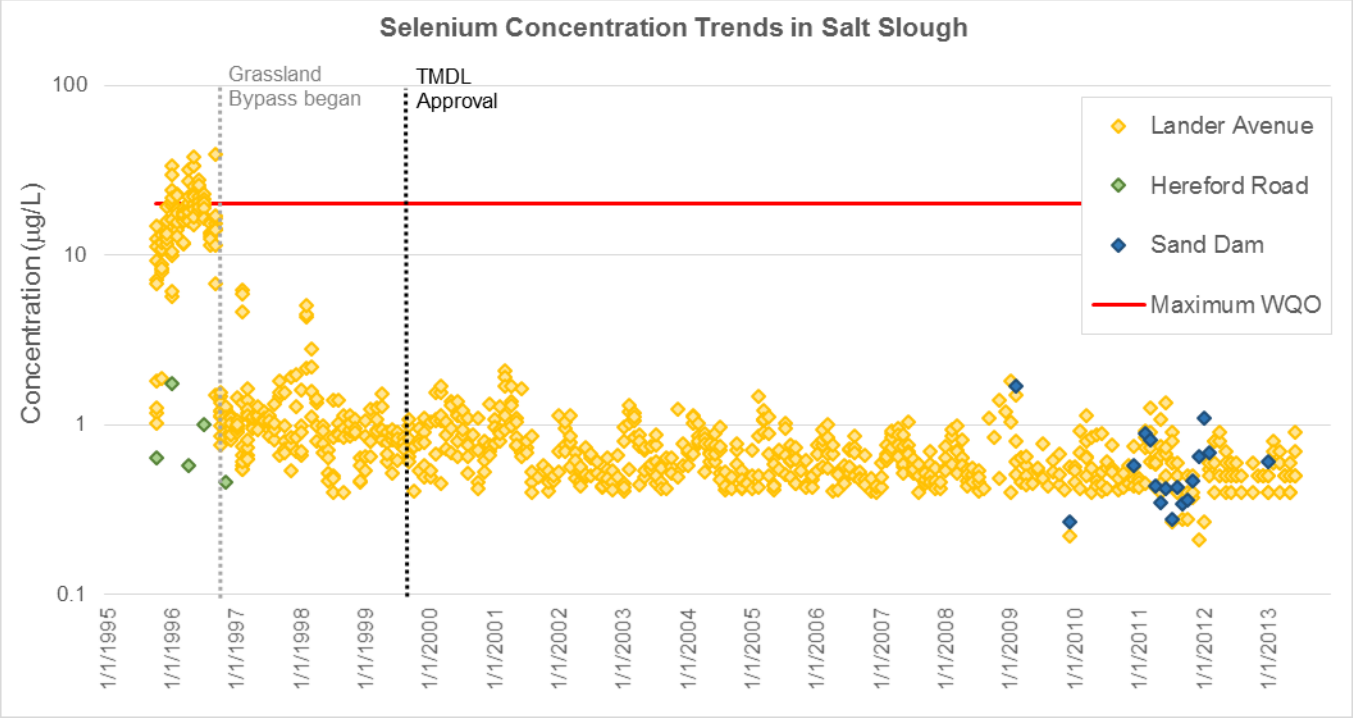
Loading Capacity and Allocations – The loading capacity is the maximum amount of a contaminant or stressor that can be assimilated in a water body without exceeding the TMDL numeric targets (equal to the water quality objectives for this TMDL). The selenium loading capacity and source allocations in this TMDL are concentration-based limits. A load limit for selenium was considered, but water quality data collected in the late 1980s though early 1990s showed little change in concentrations, even after significant selenium load reductions. It was concluded that removal of untreated subsurface agricultural drainage was required to meet water quality objectives and a concentration-based objective was the best measure of success at protecting beneficial uses and achieving water quality improvements. Therefore, the loading capacity and subsurface drainage load allocation are set equal to the water quality objective of 2 ppb, as a monthly mean, with a 20 ppb instantaneous maximum concentration. Other selenium sources to Salt Slough (surface drainage and wetlands discharge) were not identified as significant and their concentrations were consistently found to be less than the water quality objective.

Is Water Quality Improving?

Water quality has improved in the Salt Slough through the successful State prohibition of agricultural subsurface drainage to the water body. All subsurface discharge from the DPA was rerouted to the Grassland Bypass Channel where it could be controlled and regulated for progressive reductions in selenium loads. Selenium in Salt Slough now consistently meets the monthly mean water quality objective of 2 ppb (µg/L); therefore, the TMDL targets are currently being achieved. Data are shown below on two different scales. The upper graph uses a normal arithmetic scale to show monthly average selenium concentrations. This illustrates that the monthly average concentrations in Salt Slough dropped dramatically after implementation of the Grassland Bypass in 1996. After this time, only two exceedances have been observed. These exceedances were also at a smaller magnitude than those before 1996. The exceedances in 1997 and 1998 were associated with large storm events. After the 1998 El Nino year, the San Luis Delta-Mendota Water Authority developed a stormwater management plan, which addressed the violations that occurred when high flows caused subsurface drainage to be discharged to the Grassland wetlands. Since that time, no exceedances of the monthly average (2 ppb) water quality objective has been observed.



The lower graph illustrates all available data (i.e., instantaneous measurements rather than monthly averages) using a logarithmic scale to represent selenium concentrations. The instantaneous maximum water quality objective of 20 ppb is shown for comparison; this value has not been exceeded since implementation of the Grassland Bypass in 1996. The logarithmic scale illustrates that the selenium concentrations are generally between 0.5 and 1 ppb, well below the 20 ppb maximum water quality objective. Continued monitoring is being conducted to ensure this trend continues and that the current management measures remain in place.



TMDL Progress – Implementation activities and milestones

Implementation Activity	Target Date	Status	Progress Details
Attainment of water quality objectives.	10/1/1996	Complete	• Data show that selenium concentrations in Salt Slough are consistently meeting the 2 ppb monthly mean water quality objective. • The 20 ppb instantaneous maximum concentration water quality objective is also consistently being attained.
The Basin Plan contains a **prohibition of discharge** of agricultural subsurface drainage water to Salt Slough.	01/10/1997	Complete	• This prohibition was adopted in a Basin Plan Amendment for the Control of Subsurface Drainage Discharges (State Water Board Resolution 96-078). Discharge from subsurface agricultural drainage is prohibited, unless water quality objectives are being met.
Tile drainage from the DPA rerouted through the **Grasslands Bypass Structure** (portion of the former San Luis Drain) and away from the Grassland wetlands.	10/01/1996	Complete	• Beginning in September 1996 Grassland Bypass began operating (link). This consolidated the subsurface drainage from DPA into a single channel that discharges into the Mud Slough (north) via the San Luis Drain. This removed the DPA drainage from approximately 90 miles of canals that supply water to wetland habitat.
Waste discharge requirements for the Grassland Bypass Project, which require progressive load reductions.	None specified	Complete/ Ongoing	WDRs for the Grassland Bypass Project ensure that the prohibition of discharge stays in effect. • Phase I of the project regulated by Order No. 98-171. • Phase II regulated by Order No. 5-01-234 (link) • Revised WDRs and a revised monitoring and reporting program are under development by the Central Valley Water Board (link)

What Next?

Water quality goals are currently being achieved. The U.S. Environmental Protection Agency (EPA) is intending to propose new water quality criteria for the protection of aquatic life and wildlife for San Francisco Bay and the Delta by June 2016. These criteria will likely be more stringent than existing criteria for the estuary. When the new criteria are finalized, selenium loads from upstream water bodies, stormwater, and groundwater may need to be reviewed for consistency with downstream water quality standards.

Information Source Documents

- **Selenium Total Maximum Daily Load (TMDL) for Salt Slough** (link)
- **Loads of Salt, Boron, and Selenium in the Grassland Watershed and Lower San Joaquin River**, October 1985 to September 1995, California Regional Water Quality Control Board, Central Valley Region (executive summary link; raw data link)

- **Review of Selenium Concentrations in Wetland Water Supply Channels in the Grassland Watershed** (Water Year 1998 link; Water Years 1999 and 2000 link)
- **Basin Plan Amendment for the Control of Subsurface Drainage Discharges** (State Water Board Resolution 96-078), effective January 10, 1997
- **Central Valley RWQCB Resolution** – Amending the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins to Address the Control of Agricultural Subsurface Drainage, Resolution No. 96-147 (link)
- **Survey of Tributaries to Salt Slough, Merced County, California**; Central Valley RWQCB, August 1990 (link)
- **October 2014 Draft Waste Discharge Requirements and Monitoring and Reporting Program for Growers in the Grassland Drainage Area** (link; full description of the status and documentation is available at: http://www.waterboards.ca.gov/centralvalley/water_issues/grassland_bypass/)
- **Grassland Bypass Project Central Valley RWQCB website** (link)
- **Grassland Bypass Project, Summary Reports** (link)
- **Grassland Bypass Project U.S. Bureau of Reclamation website** (link)
- **A Storm Event Plan for Operating the Grassland Bypass Project**, Grassland Area Farmers and San Luis & Delta-Mendota Water Authority, 1997 (link)